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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

May 29, 1981

IE Circular No. 81-08: FOUNDATION MATERIALS

Description of Circumstances:

Insufficient compaction of foundation and backfill materials during the construction of nuclear plants has resulted in excessive settlement of plant structures at a number of sites.

At the Midland Plant, Units 1 and 2, insufficiently compacted backfill was discovered as a result of excessive settlement of the diesel generator building. The results of extensive subsurface investigations subsequent to settlement of the diesel generator building identified that fill materials beneath portions of the auxiliary building, feedwater isolation valve pits, essential service water intake structure, borated water storage tanks, and plant area utilities were not compacted to specification requirements.

Other specific nuclear power plant sites and identified problems are listed to illustrate the extent of the problem.

North Anna	Service water pumphouse settlement
Summer	Service water pumphouse settlement
Shearon Harris	Indequate moisture control in fill material
Cherokee	Inadequate field density control and soils tests
Hatch	Inadequate QC procedures and fill placement
Vogtle	Inadequate compaction, groundwater, and soil erosion controls
South Texas	Inadequate QC procedures and inspection documentation

The above problems necessitated extensive remedial work; for example, removal of large quantities of fill material, underpinning structures, surcharging foundation materials, project delays, extensive reanalysis, and, in some cases technical specification requirements pertaining to settlement monitoring during plant operation.

The causes of insufficient compaction were investigated by NRC, licensees/construction permit holders, contractors and architect-engineering firms. Based on these investigations, the various contributing causes were found to include the following:

1. Soil selection, fill, and compaction activities were not accomplished under the direction of a qualified geotechnical engineer.

2. Compaction equipment was not qualified to achieve the required compaction using the material specified, lift thickness, moisture control, equipment speed, or number of equipment passes.

3. Procedures for control of soil testing were not adequate to assure correct soil identification, selection of laboratory standards, and control of field density tests.

4. Relative density and percent compaction test results fell outside the theoretical limits, indicating an unrealistic comparison of laboratory and field density tests.

5. Soils inspections did not verify controls specified in construction specifications.

6. Quality assurance audits did not identify the procedural inadequacies or the cause of repetitive nonconforming conditions.

7. Design requirements were not properly translated into construction specifications.

8. Design change notices were not issued to reflect changes of construction specification requirements.

9. Settlement calculations based on actual design bases (i.e., load intensity, index of soil compressibility, and type of foundation) were not performed.

Recommended Action for Construction Permit Holders:

1. For those facilities with ongoing soils work activities, verify that quality assurance and quality control measures including procedures, test results, inspection personnel and audits are implemented to assure that the causes identified above do not exist for the soils work in progress or planned.

2. For those facilities with completed soils work activities that have a settlement monitoring program in effect, verify that the measured settlement values are within the projected values. In the event the measured settlement values exceed projected values, it is recommended that an investigation to determine the cause be initiated. In those cases, an evaluation which includes soil borings may be in order.

3. For those facilities with completed soils work activities that do not have an ongoing settlement monitoring program, verify that the quality assurance and quality control measures described in item 1 above were in effect during construction.

Although no specific response is required by this circular, soil compaction construction deficiencies identified and corrective actions initiated as a result of the actions recommended may be reportable in accordance with the requirements of 10 CFR 50.55e.

If you need additional information regarding this matter, contact the Director of the appropriate Regional office. .

Attachment:
Recently issued IE Circulars

Attachment
IE 81-08
May 29, 1981

RECENTLY ISSUED IE CIRCULARS

Circular No.	Subject	Date of Issue	Issued to
81-07	Control of Radioactively Contaminated Material	5/14/81	All power reactor facilities with an OL or CP
81-06	Potential Deficiency Affecting Certain Foxboro 20 to 50 Milliampere Transmitters	4/14/81	All power reactor facilities with an OL or CP
81-05	Self-Aligning Rod End Bushings for Pipe Supports	3/31/81	All power reactor facilities with an OL or CP
81-04	The Role of Shift Technical Advisors and Importance of Reporting Operational Events	4/30/81	All power reactor facilities with an OL or near-term OL
81-03	Inoperable Seismic Monitoring Instrumentation	3/2/81	All power reactor facilities with an OL or CP
81-02	Performance of NRC-Licensed Individuals While on Duty	2/9/81	All power reactor facilities (research & test) with an OL or CP
81-01	Design Problems Involving Indicating Pushbutton Switches Manufactured by Honeywell Incorporated	1/23/81	All power reactor facilities with an OL or CP
80-25	Case Histories of Radiography Events	12/5/80	All radiography licensees
80-24	AECL Teletherapy Unit Malfunction	12/2/80	All teletherapy licensees
80-23	Potential Defects in Beloit Power Systems Emergency Generators	10/31/80	All power reactor facilities with OL or a CP

OL = Operating Licenses
CP = Construction Permit